AD _____



**BUREAU OF RESEARCH AND SERVICE**
**College of Education**
**University of Illinois**
**Urbana, Illinois**

ASSUMED SIMILARITY MEASURES AS PREDICTORS OF TEAM EFFECTIVENESS IN SURVEYING

Fred E. Fiedler

Technical Report No. 6

- - -

INVESTIGATION OF THE CHARACTER AND PROPERTIES OF ASSUMED SIMILARITY MEASURES

Lee J. Cronbach, Walter Hartmann, and Mary E. Ehart

Technical Report No. 7

- - -

CORRECTION AND EXTENSION OF THE RELATIONSHIP OF INTERPERSONAL PERCEPTION TO EFFECTIVENESS IN BASKETBALL TEAMS

Fred E. Fiedler, Walter Hartmann, and Stanley A. Rudin

- - -

Studies performed under Contract N6-ori-07135
with the Office of Naval Research

Project on
Social Perception and Group Effectiveness

February, 1953

# ASSUMED SIMILARITY MEASURES AS PREDICTORS OF TEAM EFFECTIVENESS IN SURVEYING

Fred E. Fiedler
College of Education, University of Illinois

Study performed under Contract N6ori-07135
with the Office of Naval Research

Project on
Social Perception and Group Effectiveness

Technical Report No. 6
February, 1953

# ASSUMED SIMILARITY MEASURES AS PREDICTORS OF TEAM EFFECTIVENESS IN SURVEYING[1]

Fred E. Fiedler

College of Education, University of Illinois

## The Problem

The present study is one in a series of related investigations on group effectiveness (4, 5, 8). It is intended to determine, in one way, how much importance the interpersonal relations within a group have in determining the team's total effectiveness.

The limit of maximal team productivity probably lies with the available skill and talent of the individuals in the group. At the same time the effective utilization of the skill and ability of the group member depends primarily on the psychological climate and the interpersonal relationships which characterize the team. No matter how skilled an individual may be, he can contribute to the team product only to the extent to which his teammates encourage and facilitate the use of his skill (Cf. 7, 9). Voluntary restriction of output in industry is a well-known example of where the group does not permit the full utilization of skill. However, similar team

---

[1] The writer acknowledges with pleasure his indebtedness to Professor M. O. Schmidt of the Department of Civil Engineering, University of Illinois, whose interest and whole-hearted cooperation made this study possible. He also wishes to express his thanks to Professors C. S. Danner, G. H. Dell, W. H. Rayner, and L. D. Walker of the Civil Engineering Department of the University of Illinois, and to Professor Oakey, University of North Dakota, who offered many invaluable suggestions on the development of criteria, and on the administration of the study.

effects can also be found in subtler form where they are not generally expected. Thus, members of a basketball team may consciously or unconsciously hesitate to pass the ball to the best scorer because "he's got all the glory already." (5)

The effectiveness of a team is thus at least in part determined by the team members' attitudes toward their task and each other. This study will concern itself primarily with the socio-psychological determinants of team work.

Background of the Study

The present investigation represents an attempt to validate findings of a preceding study (5). This prior investigation dealt with the relation between one aspect of interpersonal perceptions of team members and the effectiveness of the team. Specifically, we measured interpersonal perception by means of Assumed Similarity scores (AS). These require that the subject (S) describe himself on a personality questionnaire. He then predicts how his most preferred and how his least preferred co-workers will describe themselves on this same questionnaire. By comparing S's self-description with his predictions of others, we derive three scores. These are the Assumed Similarity of himself to the preferred co-worker (ASp), the Assumed Similarity of himself to the not-preferred co-worker (ASn), and the Assumed Similarity between the preferred and rejected co-workers (ASo). These scores will be discussed in greater detail below.

The groups in the previous study were high school basketball teams. As criterion we used the proportion of games the team had won. A first study, frankly exploratory, was run on fourteen teams at the beginning of the season. That study suggested that the person whom most team members chose as their preferred co-worker holds a very important place in the teams. We found that members of the more effective teams chose a player who perceives relatively little similarity between himself and his designated co-workers (ASp and ASn). This person also tends to perceive his preferred and his rejected co-worker as differing (ASo). Findings of the same character were obtained for twelve additional teams tested at the end of the season. Some, but not all, of the relationships were substantial in size (Cf. 8).

In view of the multiple significance tests which were run in the first study, we are not justified in accepting these findings as confirmed beyond reasonable doubt, even though the correlation with Aso in both studies reached the .03 level of confidence with one of the criteria. Furthermore, additional validity correlations with final end-of-season criteria are lower. (See Appendix 8.) While this drop in correlations is probably due in part to changes in the teams' personnel and sociometric structure, these data suggest caution in interpreting the basketball findings.

The present study was designed to test the hypothesis that the trends obtained on basketball teams would also be found in another type of team, namely surveying parties which differ from basketball teams in terms of task, personal involvement, and size.

A further hypothesis was explored. Work prior to the basketball study (3, 4) has shown that Ss will perceive persons whom they like as more similar than persons whom they dislike. It has also been found that the more competent therapists tend to perceive their patients as more similar to themselves than do less competent therapists. These results led to the tentative interpretation that persons with low AS are relatively cold, distant persons. Hence, we are led to interpret the negative correlation of AS with performance as indicating that, in some way, warmth or congeniality adversely affects team effectiveness.

## Design of the Investigation

### Major Hypothesis

1. Members of effective groups will prefer a co-worker who perceives less similarity

(a) between himself and the persons whom he prefers as co-worker,

(b) between himself and the person whom he rejected as co-worker, and

(c) between his preferred and his rejected co-workers than the co-worker preferred by members of less effective teams.

## Selection of Groups

General criteria for selecting groups. Groups for this study had to meet certain conditions.

1. A reasonably large number of groups had to be available for testing.

2. The groups had to be engaged in the same type of task under comparable conditions.

3. A criterion of the relative effectiveness of the groups had to be available.

These conditions were adequately met by student surveying parties. These work in teams of three to four men. The subjects are second year civil engineering students taking a required course in surveying which consists of two parts. The first part of this course is taught on the University campus on a full day basis, lasting three weeks. The second part covers five weeks. It is offered at a University-operated surveying camp in Northern Minnesota where students concentrate on field problems in relatively difficult terrain.

The camp is almost completely isolated and self-contained. Students as well as faculty members eat, sleep, and work there. Recreational facilities such as a ball park and movies are provided by the University. While at camp, the students are under practically continuous supervision of their instructors. Students and instructors thus have the opportunity to get well acquainted with each other's personal and work habits.

Subjects. In all, seventy one students participated. Forty-four Ss were tested on the Urbana campus of the University of Illinois during the first week of the course, and again during the third week. In addition, thirty-four students from the University of Illinois' Navy Pier Branch in Chicago took the tests during the last week of surveying camp. Seven of the Ss later left the course. Most Chicago students live at home while attending the pre-camp classes, while most Urbana students live on campus. Aside from this fact there are no known differences between the two groups. Since the course material and entrance requirements are the same for all students, all teams have been treated as samples of the same population.

Organization of the course at camp. While at camp, the students were divided into six sections, with one instructor in charge of each of the sections throughout the camp period. Each section was made up of three or four parties, and each of the parties consisted of three to four men. Twenty-two surveying parties were formed by the instructors so that each team would consist of about equally competent students. Table 1 presents the organization of these teams.

TABLE 1

ORGANIZATION OF TEAMS AT THE SURVEYOR CAMP

| Section | Number of teams | Number of Teams Containing: 3 Men | 4 Men |
|---|---|---|---|
| I | 3 | 1 | 2 |
| II | 4 | 3 | 1 |
| III | 4 | 4 | 0 |
| IV | 4 | 3 | 1 |
| V | 3 | 3 | 0 |
| VI | 4 | 3 | 1 |

Differences between basketball teams and surveying parties. Basketball teams obviously differ in many respects from surveying parties. It might be well to point out the main differences which we see between these two types of groups.

1. Basketball teams require relatively much physical co-ordination, relatively little verbal interaction during the game. In contrast, surveying is primarily an intellectual task which requires frequent verbal communication.

2. While basketball squads consist of relatively many members, (9-18), the surveying parties in our study were no larger than four men.

3. Basketball teams work under considerable time pressure. While speed is not undesirable in surveying, it is only of secondary importance.

4. Members of basketball teams derive much of their prestige from being on a winning team. They are thus highly identified, and personally involved, with their team's success. This identification and involvement is almost completely absent in surveying teams. The students were graded individually, and no benefits were derived from being in a "good" surveying party. In fact, according to the faculty, none of the students inquired about the instructor's opinion of their team.

The Instrument and Test Procedure

As was the case in the basketball studies, students responded to four identical questionnaires under different instructions. These questionnaires contained 60 statements sampling a range of personality attributes. Statements such as, "I am very discriminating in my choice of friends," "I am not likely to admit defeat," or "When a person is a failure it is his own fault," were used.

Responses to these statement were marked on a seven point scale ranging from Definitely true to Definitely untrue. The statements were pretested on a population of 205 Air Force radio technicians who responded to a 180-item questionnaire. Statements having large item variances on self-descriptions were selection for this study.

The questionnaires were administered to all Ss as a group in Urbana, and by sections at camp. The students were informed of the general purpose of the project, and they were assured that their responses would be kept confidential. Although students were told that they might leave if they did not wish to participate, all took the tests.

Testing proceeded in two sessions.

In the first session students were asked to describe themselves on a personality questionnaire (s). They were then instructed to predict the self-descriptions of some person with whom they had in past worked well (their positive choice) (p). Thirdly, they were asked to predict the self-descriptions of a person with whom they had had much difficulty in cooperating in the past, their negative choice (n).

The second session was devoted to description of the ideal-self "describe yourself as you would ideally like to be" (i). Each student was asked (a) to name the three persons in the section whom he would most like to have as a work-companion; (b) to name the three persons whom he would least like to have as a work-companion, and (c) he was asked to name the three students in his section whom he liked best, and the three whom he liked least, on a personal basis. Finally, (d) students were asked to rank the teams in their section in order of how good they appeared to be.

Scoring Procedure

We compare the two tests by means of the statistic D(1). This enables us to obtain a score which indicates the similarity of any two of the questionnaires. Since each person took four tests, six possible measures can be obtained. This paper will discuss only the results obtained with three of these so-called Assumed Similarity Scores (or AS).

These measures are listed below with tentative interpretations.

Assumed Similarity Scores

1. ASp--Assumed Similarity to the positive choice, is obtained by comparing S's own self-description with his prediction of the self-description of his positive choice. This measure appears to be related to personal warmth and liking for the chosen person, according to previous research.

2. ASn--Assumed Similarity to the negative choice, is obtained by comparing S's own self-description with his prediction of his negative choice. A high ASn score may, on the basis of the interpretation is a above, indiciate a relatively strong feeling of personal closeness and warmth for the negative choice.

3. ASo--Assumed Similarity between opposites, is obtained by comparing S's prediction for his positive choice with his prediction for his negative choice. This measure is interpreted as "set" to differentiate people into discrete types. There is substantial intercorrelation between the three measures of assumed similarity. (Cf. 5p. 17ff.) For more extended discussion of these scores see also Technical Report 7, (2).

The Criteria of Effectiveness

For most professional activities, objective criteria of effectiveness are difficult or impossible to find. To some extent this is also true of surveying. Theoretically, the accuracy of the mapping operation can provide a criterion. Practical considerations made it impossible to obtain objective accuracy scores here, and we had to rely entirely on the instructors' judgments.

Instructors were asked to rank all teams in their section in terms of:

1. Accuracy with which surveying jobs were done by various parties,

2. Speed with which the jobs were done, and

3. Congeniality of the teams in terms of smoothness and lack of conflict in field operations.

In addition, students in all sections were asked to "rank all parties in the section from best to poorest." (Students' ratings[2].)

In light of the ultimate aims of surveying, "Accuracy" is, of course, the main criterion. It is, therefore, the only criterion on which we intended to validate the hypothesis derived from the basketball study. While speed and congeniality are desirable, they do not reflect the major emphasis in surveying. A one-tailed test of significance applies therefore to the Accuracy criterion only. Tests relating to other criteria were exploratory.

Each instructor could rank only the three or four surveying parties in his own section. To permit a comparison of parties from different sections, it was necessary to standardize the instructor ratings. AS scores for all 22 teams could then be correlated with the various criteria.

---

[2] Students' Ratings of Section V could not be used. Ss in that section had been in more than one surveyor party, and a number of students rated teams other than the main teams rated by the instructor of that section.

The fact that instructors' frames of reference differ decreases to some extent the criterion reliability. This would tend to obscure any relationships present, and it would increase the probability of accepting the null hypothesis when a true difference exists.

Table 2 presents the intercorrelations of the four criteria used in this study for three and four man parties. As can be seen, Accuracy appears to be highly correlated with Speed, moderately related to Congeniality, and negatively correlated with Students' Ratings. In other words, students' ratings seem to reflect the way in which parties get along, rather than how well they do their job. This is supported by the correlation of .39 between Congeniality and Students' Ratings.

TABLE 2

INTERCORRELATIONS (r) OF CRITERIA FOR 3--AND 4--MAN SURVEYOR TEAMS*

| | Accuracy | Speed | Congeniality Ratings | Student Ratings |
|---|---|---|---|---|
| Accuracy | -- | | | |
| Speed | .79 | -- | | |
| Congeniality Ratings | .15 | .52 | -- | |
| Student Ratings | -.34 | .15 | .39 | -- |

* Based on N's of 22 except correlations with the Student Rating Criterion where N's=18. (See Footnote 2 on page 11.)

The Accuracy criterion correlates negligibly with the Congeniality ratings. Similarly, Speed and Congeniality are not highly related. In the instructors' eyes effective (i.e., accurate) teams are thus not necessarily congenial teams.

This formulation is in accord with the preceding basketball paper. It is a finding supported by Halpin's recent study (6) as well as Schacter, Ellertson, and McBride's study (9). It is not in accord with Van Zelst's study on construction workers (10).

## RESULTS

### The Accuracy Criterion

Our major hypothesis states that the Assumed Similarity scores of most preferred co-workers in good teams will be relatively low. The preferred co-workers in relatively poor teams will have high AS scores.

Our population of teams consists of 22 surveying parties, divided into six different sections. This division presents difficulties in statistical treatment of the data since no criterion was available for comparing teams from different sections. We have, here, tested the hypothesis by two methods.

1. We compare the best and the poorest teams within each of the six sections. We can then ask whether the AS scores of the preferred co-worker in the best team from each section are lower than the AS scores of the preferred co-worker in the

poorest team in each section. Since the two teams for each section are evaluated by the same instructor, the matched t test can here be used. This does, however, reduce to 12 the number of teams (cases) used in the analysis.

Table 3

COMPARISON OF AS OF PREFERRED CO-WORKERS IN TEAMS RATED HIGHEST AND LOWEST IN ACCURACY, N=12

| Interpersonal perception scores | Mean of highest teams* | Mean of poorest teams | t | P |
|---|---|---|---|---|
| ASp | 12.96 | 12.24 | .36 | — |
| ASn | 23.10 | 15.98 | 3.86 | .01 |
| ASo | 20.61 | 15.32 | 2.75 | .025 |

* In terms of D's. A high score indicates low Assumed Similarity.

As can be seen, two of the three tests are significant. ASp shows only a negligible difference. It should be noted here that AS scores, and especially ASn and ASc, are highly correlated. The tests are therefore not independent.

2. A somewhat more satisfactory indication of the degree of relation comes from a second analysis. Criterion ratings were converted to z-scores, and then correlated with the most preferred co-worker's AS scores.

Table 4 presents the r's between the primary criterion, Accuracy, and the various AS scores. To permit comparison with the basketball study, results of the corresponding correlations in that study have

Table 4

CORRELATIONS BETWEEN AS SCORES OF MOST PREFERRED CO-WORKERS WITH TEAM EFFECTIVENESS IN BASKETBALL AND SURVEYING

| Interpersonal Perception Scores | Basketball Teams: 1st Group[3/] December 31 N=14 | Basketball Teams: 2nd Group February 18 N=12 | Surveying Parties N=22 |
|---|---|---|---|
| | Rho | $r_{p.b.}$ | r |
| ASp | -.64 | -.20 | * |
| ASn | -.41 | -.48 | -.65 |
| ASo | -.69 | -.58 | -.51 |

* Relationship inspected and found negligible

also been presented. As can be seen, the hypothesized relationship has been found between the criterion and ASn and ASo of the most preferred co-worker. Hence, persons chosen as most preferred co-workers in effective, i.e., accurate, teams tend to perceive relatively little similarity between themselves and those whom they reject as work-companions. These persons also perceive a relatively great difference between those whom they prefer and those whom they reject as co-workers. These findings thus support the results which were obtained in the study on basketball teams.

3/ Technical Report No. 3 lists correlations obtained from the December 15 criterion as -.73, -.26, and -.53 for ASp, ASn, and ASo respectively. At that time, several teams had played less than 4 games. At the time of December 31, all teams had played 8-12 games, hence the December 31 criterion is a more reliable one.

## The Secondary Criteria

As mentioned in a previous section, we asked the instructors for two ratings of teams in addition to Accuracy ratings. The instructors were asked to rate teams in terms of the Speed with which they performed their tasks, and they were asked to rank their teams in terms of the lack of conflict or Congeniality among the team members. In addition, we asked for Students' Ratings. These were obtained by asking students to rank teams in their section from best to poorest.

These three criterion ratings constitute our "secondary criteria." Table 5 lists the t's for these ratings. The results are consistent with the intercorrelations between criteria on Table 2. The findings are generally not significant. Only ASn appears to be related to Students' Ratings. This comparison yielded a t of 3.32, and a positive correlation of .34. If we had correlated each AS score with each secondary criterion nine tests are possible. This makes the significance of this one finding doubtful. The trend for this as well as other AS scores on Students' Ratings is, however, in the opposite direction of that found for Accuracy and other criteria based on instructors' ratings. In other words, the students tended to rate the teams as best in which the preferred co-worker assumed relatively high similarity to his negative choice. This appears to support the interpretation that preference for a person with high AS is related positively to congeniality within the team.

An Intrateam Preference Index, (IPI) has been defined as an index of congeniality. This measure is based on the following considerations:

1. Each person had rated the other 10-15 members of his section in terms of how well he liked them as co-workers.

2. A subject worked in a 3 or 4 man team. He could choose his preferred co-workers within his own three or four man team, or he could prefer others in his section who were not in the team.

3. We assume that a team whose members choose one another is more congenial than one whose members either reject one another or choose outsiders.

The measure is computed by the formula:

$$\text{Intrateam Preference Index (IPI)} = \frac{\text{(choices within plus rejections without)} - \text{(choices without plus rejections within)}}{nk-n}$$

n=number of men within the team

k=number of choices made by each individual.

This index was correlated with our four criterion ratings. The correlation between Accuracy and the IPI was negative (-.23) while other criterion ratings correlated positively with the index. The highest correlation was found between Students' Ratings and the IPI (.37). The t between the highest and the poorest teams was 2.24, not significant at the .05 level. These data again lead to the tentative interpretation that the teams which are most effective from a productivity standpoint are somewhat less congenial than the less productive teams.

TABLE 5

COMPARISON OF AS OF PREFERRED CO-WORKERS IN TEAMS RATED HIGHEST AND LOWEST ON SECONDARY CRITERIA, N=12

| Inter-personal perception scores | Instructor rating of Speed | | | Instructor ratings of Congeniality | | | Students' Ratings | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}_B$ | $\bar{X}_P$ | t | $\bar{X}_B$ | $\bar{X}_P$ | t | $\bar{X}_B$ | $\bar{X}_P$ | t |
| ASp | 13.81 | 15.01 | .42 | 14.12 | 14.63 | .18 | 13.49 | 15.12 | .40 |
| ASn | 20.39 | 17.71 | 1.07 | 20.22 | 20.69 | .15 | 15.83 | 19.66 | 3.32* |
| ASo | 18.41 | 15.08 | 1.30 | 18.58 | 17.22 | .43 | 14.35 | 15.17 | .59 |

* Significant below .02 level.

$\bar{X}_B$ Mean AS score of best teams.

$\bar{X}_P$ Mean AS score of poorest teams.

Cluster Scored Assumed Similarity

As in the basketball study, all results to this point are based on AS scores obtained by comparing two questionnaires item by item. We also explored AS based on scores from clusters of items. A cluster score is obtained by summing the scores on all items of a relatively homogeneious cluster. Assumed Similarity scores can then be obtained by summing the squared differences between cluster scores. The interpretation of cluster scores and the reasons for our concern with them are discussed in the accompanying Technical Report 8 (2). Validities by cluster scored AS are lower than for item scored AS, but they are in the expected direction.

ASn and ASo cluster scored, correlate -.36 and -.23 respectively with the Accuracy criterion. Evidently, for purposes of predicting group effectiveness, the type of AS measured by item scoring is more useful than AS cluster scored.

General conclusions.

This study has constituted a validity extension of the previous basketball studies. It has led to two major conclusions.

1. The Assumed Similarity scores, ASn and ASo, of the team's most preferred co-worker are negatively correlated with the team's productivity. These findings are similar to the basketball study results.

2. There is some indication here as well as in the basketball studies that the most congenial teams are not the most productive teams. Team members who select as their co-worker a person with relatively high Assumed Similarity are rated as relatively congenial. Those which select low AS persons tend to be less congenial. This relation is small in the present two studies, but it is theoretically important if it is substantiated in other studies.

## References


1. Cronbach, L. J., and Gleser, Goldine C. Similarity between persons and related problems of profile analysis. Champaign-Urbana, Illinois: 1952. (Mimeographed, Technical Report No. 2, Contract N6ori-07135 between the University of Illinois and the Office of Naval Research.)

2. Cronbach, L. J., Hartmann, W., and Ehart, Mary E. Investigation of the character and properties of assumed similarity measures. Champaign-Urbana. 1953. (Mimeographed, Technical Report No. 7, Contract N6ori-07135 between the University of Illinois and the Office of Naval Research.)

3. Fiedler, F. E. A method of objective quantification of certain counter-transference attitudes. J. clin. Psychol., 1951, 7, 101-107.

4. Fiedler, F. E., Blaisdell, F. J., and Warrington, W. G. Unconscious attitudes as correlates of sociometric choice in a social group. J. abnorm. soc. Psychol. 1952, 4, 790-796.

5. Fiedler, F. E., Hartmann, W., and Rudin, S. A. The relationship of interpersonal perception to effectiveness in basketball teams. Champaign-Urbana, Illinois: 1952. (Mimeographed, Technical Report No. 3, Contract N6ori-07135 between the University of Illinois and the Office of Naval Research.)

6. Halpin, A. W. "The relation between the crew's perception of the leadership behavior of airplane commanders and superiors' ratings of their combat performance." Paper presented at American Psychological Association meetings, Washington, D. C. 1952.

7. Martin, W. E., Darley, J. G., and Gross, N. Studies of group behavior: Methodological problems in the study of interrelationship of group members. Educ. psychol. Measmt., 1952, 12, Winter Number.

8. Fiedler, F. E., Hartmann W., and Rudin, S. A. Correction and extension of The relationship of interpersonal perception to effectiveness in basketball teams. Champaign-Urbana, Illinois. 1952. (Mimeographed, Supplement to Technical Report No. 3, Contract N6ori-07135 between the University of Illinois and the Office of Naval Research.)

9. Schachter, S., Ellertson, N., McBride, Dorothy, and Gregory, Doris. An experimental study of cohesiveness and productivity. Hum. Relat., 1951, 4, 229-238.

10. Van Zelst, R. H. Sociometrically selected work teams increase production. Pers. psychol. 1952, 3, 175-185.